CHAPTER THREE: THE PRESENT STUDY

This Chapter is basically a description of the selection of the GaDangme communities (i.e. dialects) as well as speakers used in the study. It also presents actual procedures employed in acquisition and analysis of the phonetic data. Finally, it presents the method of data normalization employed in the study.

3.1 SELECTION OF DIALECT AREA:

In this investigation, recordings were made in three Ga speaking communities and three Dangme speaking communities. The communities were selected such that a wide area of the language is covered so that each language is well represented in the study. For instance, no two communities were selected if they were adjacent to each other. In the case of Ga, care was taken to include one urban community in Accra Central, namely, Bukom; one suburban community, namely, Teshie; and one rural community, namely, Abokobi. In the Dangme language area, one town each was selected from the three major dialect areas of Ada (i.e., Big Ada), Shai (i.e., Doryumu), and Krobo (i.e., Odumase). Time constraints did not allow for more Dangme communities to be investigated even though the Dangme area is almost three times the size of the Ga area. It is hoped, however, that the communities selected are a true representation of the Dangme population of Ghana. This is because the selection included the two extreme Dangme dialects (i.e., Ada and Krobo) together with one centrally placed (i.e., Shai).

3.2 SELECTION OF SPEAKERS:

10 speakers each – comprising five male and five female – were selected from each selected community. Emphasis was placed on monolingual (or near monolingual) speakers who were literate in the GaDangme language. This is to ensure that the phonetic data acquired was truly GaDangme. The average age of the subjects was 40 years, with individual ages ranging from 25 to 65 years old. Younger people were excluded because the majority of them, even in the rural areas, use more English than GaDangme. Based on the findings of Brückl and Sendlmeier (2003) that there is increased amplitude perturbation in the speech of old people, very old people were excluded from the study. Also, it is quite difficult finding literate people in their seventies, especially in the rural areas. All subjects were indigenous speakers who have been living in the stated areas for most of their lives and use the GaDangme language in most of their daily encounters.

3.3 DATA COLLECTION:

The study was limited to only 12 out of the suggested 36 vowel phonemes of the GaDangme language. The 12 vowels included the 7 oral vowels and the 5 nasalized vowels. The tonal variations were eliminated by using only the high tone across board. This is in line with research findings (on tonal effects on vowel quality) such as that of

Zee (1978) which indicate that vowel quality is affected by different tones. The vowels were produced in monosyllabic words with bilabial consonants at word initial position.

The vowels were embedded in monosyllabic words preceded by a bilabial consonant. This yielded the series of words: bi, be, bɛ, ba, bɔ, bo, bu, bĩ, bɛ̃, bã, bɔ̃. bũ, (See Tables 3.1 and 3.2.) Some of the monosyllabic words resulting from the nasalized vowels were nonsense words. Where such nonsense words were used, a few real words in similar environments were recorded in addition to the nonsense words so as to check the validity of the vowel in the nonsense word. The test words were embedded in the carrier frames: "Kɛɛmɔ _ pɛ" for Ga and "Mo de _ pɛ" for Dangme. (The English gloss of the carrier frame is 'Say….. only'.) By this arrangement, the target vowels were placed between two bilabial consonants. The target vowels occurred in the same phonetic environment so as to make influence of preceding and following segment remain constant. Each sentence containing the target vowel was written on a two-inch by three-inch card and presented to the speakers to read. Five additional stimuli were added at the beginning and end of the list in order to eliminate 'beginning' and 'end' effects. Every sentence was repeated three times in the corpus, yielding a total of 30 tokens per target vowel per community (i.e. dialect area). Thus for both Ga and Dangme communities, there were 90 tokens of each vowel phoneme for a grand total of 180 tokens per GaDangme vowel phoneme.

The subjects were made to sit as still as possible during recording and to read the carrier sentences as naturally as possible. The English gloss of the word containing the target vowels were provided in parenthesis beneath each test word. This is to eliminate any sources of ambiguity resulting from tones.

Recordings were made by means of a Sony IC recorder in quiet areas with background noise as minimal as possible. The volume of the recorder was controlled so that the volume remained just high enough for the recording. The microphone of the recorder was kept about five inches away from the lips and at an angle of about 45°. The recorded vowels were later digitized using the Kay Elemetrics Computerized Speech Laboratory software, at a sampling rate of 11025Hz.

Tables 3.1 and 3.2 show the monosyllabic words used in the carrier sentences for both Ga and Dangme, respectively, together with their IPA transcriptions as well as English gloss of each word.

3.4 DATA ANALYSIS:

The vowels were segmented on the basis of visual information in a wide band spectrogram. The first and second formant frequency values of the vowels were measured in the middle of the vowel so as to minimize the influence of adjacent segments and also to minimize any transitional effects on the vowels. (See Figures 3.1 and 3.2.) This conforms with Well's statement that "the measurement of a vowel's formants should ideally be made at a point in time where the influence of the preceding consonant has died away and that of the following consonant has not yet appeared".

Table 3.1: Ga word list

WORD	IPA TRANSCRIPTION	ENGLISH GLOSS
Tsofa	[ʧofa]	Medicine
Tsobi	[ʧobi]	Dull
Bi	[bi]	Child
Be	[be]	Quarrel
Bɛ	[bɛ]	Don't have
Ba	[ba]	Come
Bɔ	[bɔ]	Dew
Bo	[bo]	Soften
Bu	[bu]	Hole
Fi	[fi]	Support
Bi	[bi]	Nonsense word
Fɛlɛ	[fɛlɛ]	Itch
Bɛ	[bɛ]	Nonsense word
Fa	[fa]	Half
Ba	[ba]	Nonsense word
Obɔ	[obɔ]	Full
Bɔ	[bɔ]	Nonsense word
Fu	[fu]	Rise
Bu	[bu]	Nonsense word
Bɔfo	[bɔfo]	Angel
Gbɔmɔ	[gbɔmɔ]	Human being

Figure 3.1 represents the waveform (top box) and the wideband spectrographic representation (bottom box) of a male Ga speaker from Abokobi saying the utterance "Kɛɛmɔ be pɛ" three times. The two boxes are the visual representations of the acoustic signals. The waveform shows variations in air pressure as the speaker makes the utterance. Periods of vibration of the vocal cords are shown by vertical pulses while periods of silence are shown by a single horizontal line. The wideband spectrogram also shows vertical striations which represent the vibrations of the vocal chords during the utterance. Events in the two boxes are synchronized, making it possible for one to map each waveform onto its spectrographic representation. (Time is indicated on the horizontal axis.) Note the cursor position approximately in the center of the target vowel. This is used to identify and read out specific acoustic values at any moment in time.

Table 3.2: Dangme word list

WORD	IPA TRANSCRIPTION	ENGLISH GLOSS
Gba	[gba]	Tear
Bli	[bli]	Open
Bi	[bi]	Ask
Be	[be]	not in
Bɛ	[bɛ]	Broom
Ba	[ba]	Come
Bɔ	[bɔ]	Dew
Boboobo	[bobo:bo]	very loud
Bo	[bo]	Nonsense word
Bu	[bu]	Cover
Gbli	[gblĩ]	Dry
Bi	[bi]	Nonsense word
Gigɛ	[gĩgɛ̃]	Groundnut
Bɛ	[bɛ̃]	Nonsense word
Sa	[sã]	Flatulate
Ba	[bã]	Nonsense word
Bɔ	[bɔ̃]	tribal mark
Du	[dũ]	Sow
Bu	[bũ]	Nonsense word
Kplu	[kplu]	Cup

On the wideband spectrogram, voicing is represented by vertical striations with each vertical line representing a single pulse of the vocal folds. Non voicing is basically silence and does not show on a spectrogram. Where the vocal chords are not vibrating, for instance, in the production of voiceless sounds, the striations are absent. The vertical striations of a voiced source can be seen as going all the way up the spectrum through all frequencies. (Frequency is indicated on the vertical axis.) The dark horizontal bands found in the figures represent the formants of the various sounds in the utterance.

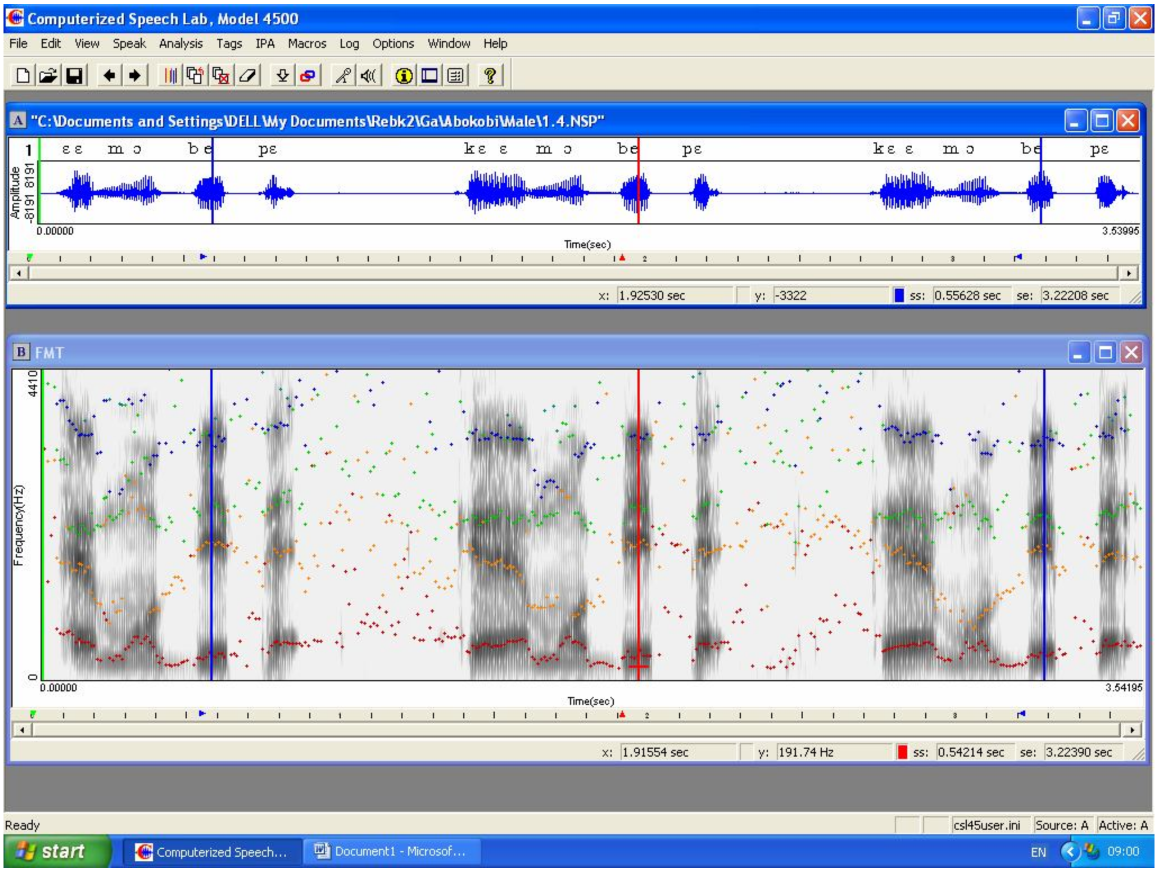

Figure 3.1 *Waveform and spectrogram of a male speaker of Ga from Abokobi dialectal area repeating "Kεεmɔ be pε" three times. The points in time at which the formant values were measured are indicated on the spectrograms with vertical lines.*

Depending on the shape of the vocal cavity, some frequencies get boosted and others suppressed i.e. the energy in the striation is being filtered by the vocal tract. A single striation therefore fades in and out as one goes up the frequency scale. The bunch of striations lined up over time form horizontal bands of darkness where the frequencies are boosted and areas of lightness where they are suppressed and these form the formants. A formant is a dark band on a wideband spectrogram, which corresponds to a vocal tract resonance. Technically, it represents a set of adjacent harmonics which are boosted by a resonance in some part of the vocal tract. Different vocal tract shapes therefore will produce different formant patterns. In wideband spectrograms, stops (especially orals) are shown by silence because of the complete occlusion of the vocal tract in their production.

Figure 3.2 is the Dangme version of the same, namely, "Mode be pε", as said three times by a male speaker from Big Ada.

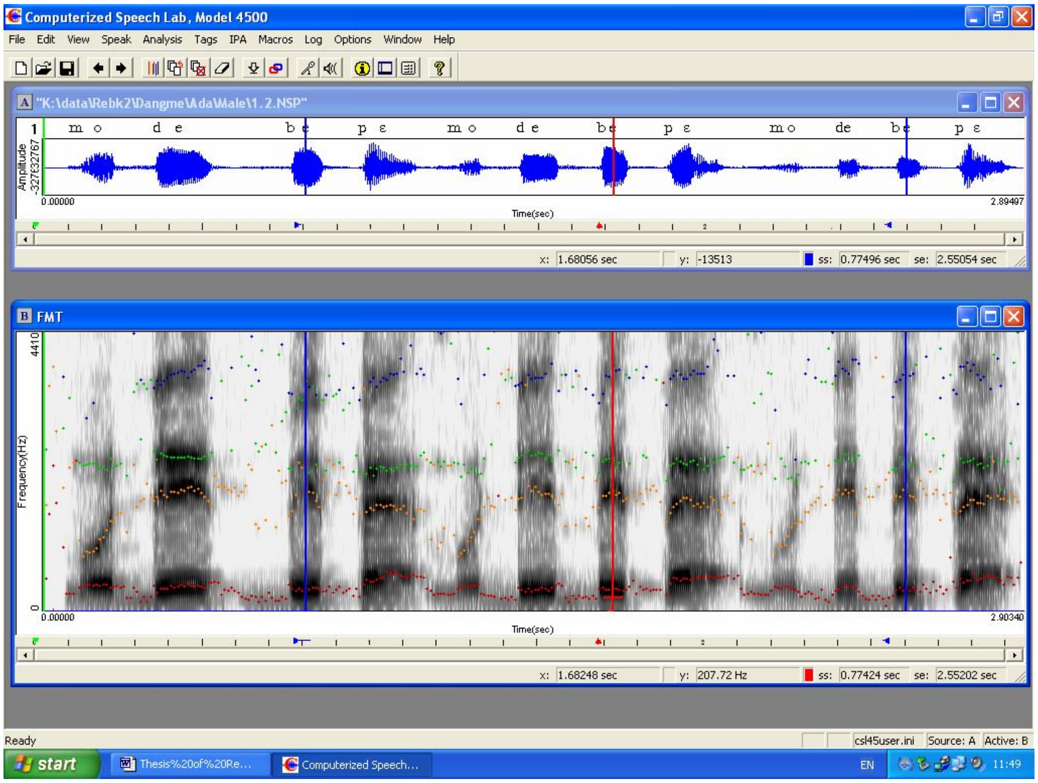

Figure 3.2 *Waveform and spectrogram of a male speaker of Dangme from Ada dialectal area repeating "Mode be pɛ" three times. The points in time at which the formant values were measured are indicated on the spectrograms with vertical lines.*

Reading from the bottom of the spectrogram, the first dark horizontal band is the first formant (F1); the second dark band is the second formant (F2); the third dark band is the third formant (F3); and then there is the fourth (F4); and, in some cases, the fifth, sixth or even seventh formants. The first three formant frequencies, which represent the vocal tract shape in the production of various vowels, are said to yield the most linguistic information. (See discussion in Section 3.5.) The higher formants are reputed to show individual characteristics of different speakers. In this regard, they serve as 'voiceprints' of the particular speaker.

3.5 JUSTIFICATION FOR SPECTROGRAPHIC ANALYSIS:

Peter Ladefoged, (1993) states in, *A Course in Phonetics*, (third edition) that "the quality of a sound such as the vowel, depends on its overtone structure". These characteristic overtone structures which are a result of the total supralaryngeal vocal tract configuration are the formants of the vowels. Vowels are distinguished by three characteristic overtone pitches namely the first formant (F1), the second formant (F2), and the third formant, F3. The first formant, F1, which increases in frequency values from /i/ to /æ/ and decreases

from /ɑ/ to /u/, corresponds inversely to the traditional height of the body of the tongue in the production of vowels. For instance /i/ and /u/ which usually have the lowest F1 values are produced with the body of the tongue at its highest point in the oral cavity while /a/ and /ɑ/ which usually have the highest F1 values are produced with the body of the tongue at its lowest point. The second formant, F2, corresponds inversely to the rounding of the lips as the sound is produced. For instance, /i/ with the highest second formant frequency is produced with no lip rounding but /u/ with the least second formant frequency value is produced with the most lip rounding. F2 also represents the relative frontness or backness of the vowel as stated by Kent & Read (1992) cited by Scott Shank and Ian Wilson (2000) such that the higher the F2 value the more front the sound is, and the lower the F2 value, the farther back the vowel.

Ladefoged suggests that the greater the difference between the first and second formant frequencies the more front the sound is. Akpanglo-Nartey (2002), suggests that the relationship between relative backness and F2 is more complex than this. Wells J. C (1962) shares this view by stating that "the relationship of acoustic and articulatory parameters is complex. Very grossly, the first formant rises as the tongue height decreases; the second formant falls as the highest part of the tongue moves from front to back. But the shape of the vocal tract is such that its acoustical characteristics are rather complicated."

Based on the above arguments as well as others raised in Chapter 2, the present study focuses on measures derived from only the first and second formant.

3.6 STATISTICAL ANALYSIS:

A one-way analysis of variance (ANOVA) was performed on the data using an SPSS package. Tests of significance were carried out on individual vowel sounds per community (dialect area) within each language. Also, pair wise tests of significance were conducted for vowel pairs, including /i,e/, /e,ɛ/ /ɛ,a/, /a,ɔ/, /o,ɔ/, and /u,o/. Additionally, tests of significance were conducted between cognate oral and nasalized pairs. Finally, all Ga vowels were compared with all Dangme vowels for significance.

The results of the statistical tests are presented in Chapter 4.